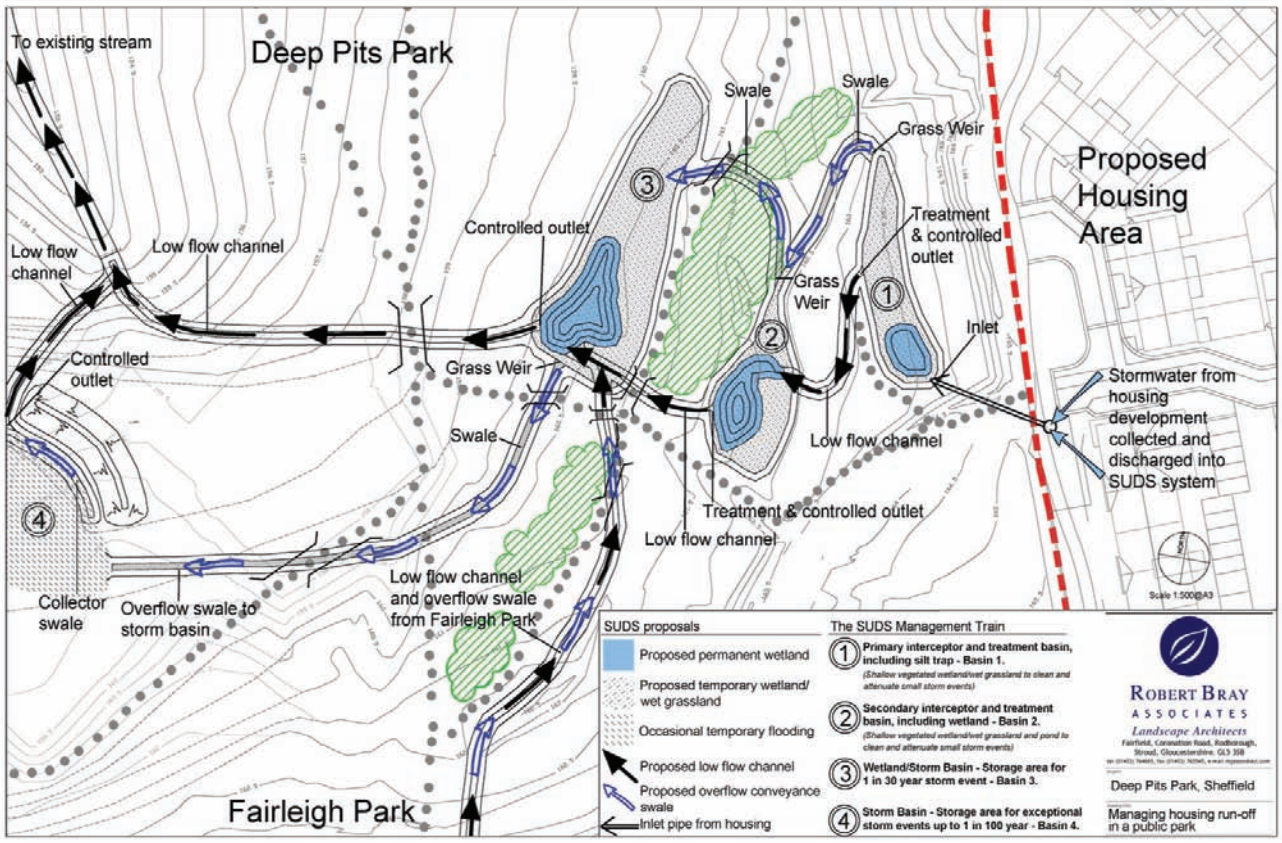
Appendices

A. Example of maintenance costs

Costs for SUDS in public park

The costs to maintain the SUDS scheme shown on the plan below have been estimated. The scheme serves a housing estate to the east of the site which delivers unattenuated and untreated runoff to the system. The system was approved and adopted by the local authority (Sheffield City Council). It is located in a park that is also owned and managed by the local authority. The system has been operational since 2006 and dealt easily with flows that occurred during heavy rainfall that caused heavy flooding in other parts of Sheffield in 2007.



Example - SUDS in public open space or park

SUDS scheme

Item	Description	Unit	Total
1	Overall park area	m2	40000
2	Ponds/wetlands (total area)	m2	650
3	Ponds/wetlands (water area)	m2	325
4	Retention basin	m2	2800
5	Swale	m	415
6	Control structures	No	9
7	Catchment area (impermeable)	m2	23600

General rates - cost per visit to site **40000 m2 site**

No per year	Item	Unit	Rate	Total per visit for site inc all SUDS 40000 m2 site	Total per visit for site if no SUDS in site	Comments
12	Litter removal	100m2	0.67	£268.00	£268.00	
12	Inspect control structures to pond or wetland (assumes surface features and no special tools required)	Item	5	£45.00	£0.00	£20 per control structure
12	Grass cutting on slopes around pond above temporary water level - amenity grass	100m2	1.14	£448.59	£456.00	Total park area minus pond area assumed for SUDS costs
1	Scrub clearance from bankside	100m2	5.83	£91.53	£0.00	Around SUDS ponds and swale only only
1	Cut 25% to 30% wetland vegetation and remove to site wildlife piles	100m2	3.38	£21.97	£0.00	
1	Removal of all arisings (scrub clearance and wetland vegetation)	100m2	2.65	£50.22	£0.00	
	Total per visit if all items completed			**£925.31**	**£724.00**	
	Total per visit for litter removal, inspection and grass cutting			**£761.59**	**£724.00**	
	Total annual cost			**£9,302.80**	**£8,688.00**	
	Additional annual cost for presence of SUDS for a 40000 m2 site including a 15% contingency for unexpected work.			**£707.02**	**Plus silt removal every 5 years £907.97**	

Cost per visit based on labour rates

Item	No	Unit	Rate	Full day (8 hours)
Labourers x 3	8	hour	15.5	372.00
Light van (eg transit)	1	day	36	36.00
Small ride on mower	8	hour	8.75	70.00
Ancillary tools and equipment	1	day	20	20.00
Disposal of cuttings off site	1	Item	150	150.00
Total per visit				**498.00**
Total for 12 visits per year				**5976.00**
Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow one extra visit per year				**498.00**

Pond silt removal every 5 years

Assume a specific visit is made for this work	No	Unit	Rate	Full day (8 hours)
Labourers x 3	8	hour	15.5	372.00
Light van (eg transit)	1	day	36	36.00
Small mini excavator, rubber tracks (self drive)	8	hour	8.75	70.00
Delivery charge in Cambridge from local hire company	1	Item	30	30.00
Ancillary tools and equipment	1	day	20	20.00
Disposal of silt (volume depends on catchment area)	7.42	m^3	51.18	379.97
Total				**907.97**

Notes
All rates and base costs taken from SPON'S External Works and Landscape Price Book 2008

Silt loading

Parameter	Units	Value	
Silt load (TSS)	kg/ha/yr	755	Maximum load for high density housing
Silt density in pond	kg/m^3	1200	
Silt accumulation pond	m^3/y/ha impermeable catchment area	0.63	
Total silt accumualtion over 5 years for catchment	m^3	7.42	

B. Detailed maintenance costs for each feature

Maintenance requirements and costs of ponds and wetlands

Most of the maintenance will be required as part of the overall open space maintenance. The costs are based on the assumption that a specific visit to site is made to carry out the maintenance in the SUDS pond or wetland. If they are incorporated into the general maintenance there will only be some additional costs where extra work relating to the SUDS feature needs to be undertaken above and beyond the cost for the general landscape. Items that are specific to a SUDS pond or wetland that will be carried out in addition to general landscape maintenance are highlighted in blue. The costs assume that access to the site is easy. Minimum costs are based on the cost to visit a site and the rates for larger areas are based on information in the SPON's External Works and Landscape Price Book 2008 and will be updated as necessary. There is no allowance for profit in the costs.

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Frequency</th><th rowspan="2">Comments</th><th colspan="2">Cost</th></tr>
<tr><th>Minimum cost for small areas of POS (based on fixed cost of a site visit)</th><th>£/100m^2 per visit for larger POS areas</th></tr>
<tr><td>Litter removal</td><td>1 per month</td><td>Litter quantity and characteristics will be dependant on the site
Litter may collect in ponds and wetland features
Litter collection may be part of the general landscape maintenance
Litter collection should be undertaken at each site visit and the beginning of any maintenance task, particularly grass cutting
All litter must be removed from site</td><td rowspan="6">1 site visit with 3 men, 1 light van, mower and ancillary equipment.
Half day visit comprises 3 hours on site and 1 hour travelling.
Half day maximum POS area including SUDS is about 4000 m^2 (including pond or wetland vegetation).
Cost per visit = £249
Full day visit comprises 7 hours on site and 1 hour travelling.
One day maximum POS area including SUDS is about 10000m^2 (including pond or wetland vegetation)
Cost per visit = £498</td><td>0.67</td></tr>
<tr><td>Inspect control structures to/from pond or wetland</td><td>1 per month</td><td>Surface control structures can be slot weirs, V-notch or gabion baskets with control in the stone fill. They can be inspected without removing covers or special keys</td><td>£5/ structure</td></tr>
<tr><td>Grass cutting on slopes around pond above temporary water level – amenity grass</td><td>1 per month</td><td>All grass cuttings managed on site in wildlife or compost piles</td><td>1.14</td></tr>
<tr><td>Scrub clearance from bankside</td><td>1 per year</td><td>Overhanging branches and encroaching growth will normally be undertaken as part of landscape maintenance</td><td>5.83</td></tr>
<tr><td>Cut 25% to 30% wetland vegetation and remove to site wildlife piles</td><td>1 per year</td><td></td><td>3.38</td></tr>
<tr><td>Remove planting and silt from 25% to 30% of base and place in site piles</td><td>1 per 5 years</td><td>Silt accumulation is slow if 'source control' features are located upstream in the 'management train'
Only required once every 5 years</td><td colspan="2">Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment. Total pond area up to 1200m^2
Cost per visit = £689
Disposal of silt by truck with mechanical grab (assuming it is not special waste) £51.18/m^3</td></tr>
<tr><td>Extra cost if silt, grass cuttings, etc are removed from site during routine maintenance</td><td>To suit other operations</td><td>Ideally all cuttings should be used on site to construct and maintain wildlife piles but this may not be the best option in public open space and removal from the site may be needed.</td><td colspan="2">£2.65/100m^2 cleared.
Assumes the waste is not classified as special waste and proportion of silt is minor (which should be the case if source control is in place upstream). Disposal of silt by truck with mechanical grab (assuming it is not hazardous or special waste) £55/m^3</td></tr>
</table>

= SUDS Specific Items

Ponds and Wetlands

No per year	General rates - cost per visit to site	10000 m2 site				
	Item	**No**	**Unit**	**Rate**	**Total per visit for site inc all SUDS 10000 m2 site**	**Page reference in SPON'S**
12	Litter removal	10000	100m2	0.67	67	Pg 216 collection and disposal of litter from isolated grassed area
12	Inspect control structures to pond or wetland (assumes surface features and no special tools required)	4	No	5	20	Allow £5 per structure
12	Grass cutting on slopes around pond above temporary water level - amenity grass	10000	100m2	1.14	114	Page 214 self propelled rotary mower, 91cm cut width, removing arisings not exceeding 30 deg from horizonal (0.36 + 0.78 = 1.14)
1	Scrub clearance from bankside	10000	100m2	5.83	583	Page 216 use rate for clearing leaf and other debris from verges by hand
1	Cut 25% to 30% wetland vegetation and remove to site wildlife piles	2500	100m2	3.38	84.5	Page 214 cutting grass or light woody undergrowth using strimmer not exceeding 30 deg
1	Removal of all arisings (scrub clearance and wetland vegetation)	2500	100m2	2.65	66.25	Page 216 use rate for removal of arisings from areas containing shrub beds.
	Total per visit if all items completed				**934.75**	
	Total per visit for litter removal, inspection and gress cutting				**201**	
	Total annual cost				**3145.75**	
	Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow 15%				**471.86**	

Cost per visit based on labour rates

Item	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 3	8	hour	15.5	186.00	372.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small ride on mower	8	hour	8.75	35.00	70.00	Assumes rate for mower is same as for a mini excavator, self drive and no delivery charge or minimum hire
Ancillary tools and equipment	1	day	20	10.00	20.00	Allowance for tools such as strimmers, etc
Disposal of cuttings off site	1	Item	150	150.00	150.00	Cost based on small skip specific for disposal from a particular site - 6m^3 (The more sites that are maintained the less this cost may become)
Total per visit				**249.00**	**498.00**	
Total for 12 visits per year				**2988.00**	**5976.00**	
Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow one extra visit per year				**249.00**	**498.00**	

Pond silt removal every 5 years

Assume a specific visit is made for this work	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 3	8	hour	15.5	186.00	372.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small mini excavator, rubber tracks (self drive)	8	hour	8.75	35.00	70.00	Page 15, self drive and no delivery charge. Minimum hire 8 hours
Delivery charge in Cambridge from local hire company	1	Item	30	30.00	30.00	Assume £30 for both ways
Ancillary tools and equipment	1	day	20	10.00	20.00	Allowance for tools such as strimmers, etc
Disposal of silt for SUDS serving 1 Ha site (volume depends on catchment area)	0.63	m^3	51.18	161.00	161.00	Allow 0.63m^3 per year per ha of catchment area (impermeable), based on 755kg/ha/yr and density of 1200kg/m^3 from Darcy et al (2000). Cost from Page 106, wet clay
Total				**440.00**	**689.00**	

Notes
All rates and base costs taken from SPON'S External Works and Landscape Price Book 2008

Silt loading

Parameter	Units	Value	
Silt load (TSS)	kg/ha/yr	755	Maximum load for high density housing
Silt density in pond	kg/m^3	1200	
Silt accumulation pond	m^3/y/ha impermeable catchment area	0.63	

Maintenance requirements and costs of basins

Most of the maintenance will be required as part of the overall open space maintenance. The costs are based on the assumption that a specific visit to site is made to carry out the maintenance in the SUDS basin. If they are incorporated into the general maintenance there will only be some additional costs where extra work relating to the SUDS feature needs to be undertaken above and beyond the cost for the general landscape. Items that are specific to a basin that will be carried out in addition to general landscape maintenance are highlighted in blue. The costs assume that access to the site is easy. Minimum costs are based on the cost to visit a site and the rates for larger areas are based on information in the SPON's external works and landscape price book 2008 and will be updated as necessary. There is no allowance for profit in the costs.

Item	Frequency	Comments	Cost	
			Minimum cost for small areas of POS (based on fixed cost of a site visit)	£/100m^2 per visit for larger areas of POS
Litter removal	1 per month	Litter quantity and characteristics will be dependant on the site Litter may collect in ponds and wetland features Litter collection may be part of the general landscape maintenance Litter collection should be undertaken at each site visit and the beginning of any maintenance task, particularly grass cutting All litter must be removed from site	1 site visit with 3 men, 1 light van, mower and ancillary equipment. Half day visit comprises 3 hours on site and 1 hour travelling. Half day maximum area = 4000 m^2 (including pond or wetland vegetation) Cost per visit = £249	0.67
Inspect control structures to/from basin	1 per month	Surface control structures can be slot weirs, V-notch or gabion baskets with control in the stone fill. They can be inspected without removing covers or special keys. Maintenance of control structures in manhole chambers will be more expensive.		£5/ structure
Grass cutting on slopes and in bottom of basin – amenity grass	1 per month	All grass cuttings managed on site in wildlife or compost piles	Full day visit comprises 7 hours on site and 1 hour travelling. One day maximum area = 10000m^2 (including pond or wetland vegetation) Cost per visit = £498	1.14
Scrub clearance from bankside	1 per year	Overhanging branches and encroaching growth will normally be undertaken as part of landscape maintenance		5.83
Habitat mosaic 30% cut and remove to site wildlife piles (see Section on ponds and wetlands)	1 per year	Carry out September to November if possible to minimise disruption to wildlife		3.38
Scarify and spike base of infiltration basin if necessary at same time	1 per 5 years	This would typically be undertaken at the same time and as part of the visit to remove silt.	Inc in silt removal costs with nominal extra allowance for scarifying plant	1.29
Remove silt from base and place in site piles (see Section on ponds and wetlands)	1 per 5 years	Silt accumulation is slow if 'source control' features are located upstream in the 'management train' Only required once every 5 years	Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment. Basin area up to 1200m^2 Cost per visit = £689 Disposal of silt by truck with mechanical grab (assuming it is not special waste) £51.18/m^3	
Extra cost if silt, grass cuttings, etc are removed from site during routine maintenance	To suit other operations	Ideally all cuttings should be used on site to construct and maintain wildlife piles but this may not be the best option in public open space and removal from the site may be needed.	£2.65/m^2 cleared. Assumes the waste is not classified as special waste and proportion of silt is minor (which should be the case if source control is in place upstream). Disposal of silt by truck with mechanical grab (assuming it is not hazardous or special waste) £55/m^3	

= SUDS Specific Items

Basins

No per year	General rates - cost per visit to site	10000 m^2 site No	Unit	Rate	Total per visit for site inc all SUDS 10000 m2 site	Page reference in SPON'S
12	Litter removal	10000	$100m^2$	0.67	67	Pg 216 collection and disposal of litter from isolated grassed area
12	Inspect control structures to basin (assumes surface features and no special tools required)	4	No	5	20	Allow £5 per structure
12	Grass cutting on slopes and in bottom of basin - amenity grass	10000	$100m^2$	1.14	114	Page 214 self propelled rotary mower, 91cm cut width, removing arisings not exceeding 30 deg from horizonal (0.36 + 0.78 = 1.14)
1	Scrub clearance from bankside	10000	$100m^2$	5.83	583	Page 216 use rate for clearing leaf and other debris from verges by hand
1	Habitat mosaic 30% cut and remove to site wildlife piles	3300	$100m^2$	3.38	111.54	Page 214 cutting grass or light woody undergrowth using strimmer not exceeding 30 deg
1	Removal of all arisings (scrub clearance and vegetation)	3300	$100m^2$	2.65	87.45	Page 216 use rate for removal of arisings from areas containing shrub beds.
	Total per visit if all items completed				**982.99**	
	Total per visit for litter removal, inspection and grass cutting				**201**	
	Total annual cost				**3193.99**	
	Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow 15%				**479.10**	

Cost per visit based on labour rates						
Item	**No**	**Unit**	**Rate**	**Half day (4 hours)**	**Full day (8 hours)**	**Page reference in SPON'S**
Labourers x 3	8	hour	15.5	186.00	372.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small ride on mower	8	hour	8.75	35.00	70.00	Assumes rate for mower is same as for a mini excavator, self drive and no delivery charge or minimum hire
Ancillary tools and equipment	1	day	20	10.00	20.00	Allowance for tools such as strimmers, etc
Disposal of cuttings off site	1	Item	150	150.00	150.00	Cost based on small skip specific for disposal from a particular site - $6m^3$ (The more sites that are maintained the less this cost may become)
Total per visit				**249.00**	**498.00**	
Total for 12 visits per year				**2988.00**	**5976.00**	
Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow one extra visit per year				**249.00**	**498.00**	

Basin silt removal, scarifying and spiking every 5 years						
Assume a specific visit is made for this work	**No**	**Unit**	**Rate**	**Half day (4 hours)**	**Full day (8 hours)**	**Page reference in SPON'S**
Labourers x 3	8	hour	15.5	186.00	372.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small mini excavator, rubber tracks (self drive)	8	hour	8.75	70.00	70.00	Page 15, self drive and no delivery charge. Minimum hire 8 hours
Delivery charge in Cambridge from local hire company	1	Item	30	30.00	30.00	Assume £30 for both ways
Ancillary tools and equipment to scarify and spike	1	day	40	20.00	40.00	Allowance for tools such as strimmers, pedestrian operated scarifying equipment, etc
Disposal of silt from SUDS serving 1 Ha catchment (volume depends on catchment area)	0.63	m^3	51.18	161.00	161.00	Allow $0.63m^3$ per year per ha of catchment area (impermeable), based on 755kg/ha/yr and density of $1200kg/m^3$ from Darcy et al (2000). Cost from Page 106, wet clay
Total				**485.00**	**709.00**	

Notes
All rates and base costs taken from SPON'S External Works and Landscape Price Book 2008

Scarifying and spiking every five years General rates - cost per visit to site, $10000m^2$ site					
Item	**No**	**Unit**	**Rate**	**Total per visit for $4000m^2$ site inc all SUDS**	**Page reference in SPON'S**
Scarifying using pedestrian operated plant	10000	$100m^2$	1.29	129	Pg 215 Scarifying mechanical
Removal and disposal of arisings	10000	$100m^2$	11.41	1141	Pg 215

Silt loading			
Parameter	**Units**	**Value**	
Silt load (TSS)	kg/ha/yr	755	Maximum load for high density housing
Silt density in basin	kg/m^3	1200	
Silt accumulation basin	$m^3/y/ha$ impermeable catchment area	0.63	

Maintenance requirements and costs of swales and filter strips

Most of the maintenance will be required as part of the overall open space maintenance. The costs are based on the assumption that a specific visit to site is made to carry out the maintenance in the SUDS swale or filter strip. If they are incorporated into the general maintenance there will only be some additional costs where extra work relating to the SUDS feature needs to be undertaken above and beyond the cost for the general landscape. Items that are specific to a SUDS swale or filter strip that will be carried out in addition to general landscape maintenance are highlighted in blue. The costs assume that access to the site is easy. Minimum costs are based on the cost to visit a site and the rates for larger areas are based on information in the SPON's External Works and Landscape Price Book 2008 and will be updated as necessary. There is no allowance for profit in the costs.

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Frequency</th><th rowspan="2">Comments</th><th colspan="2">Cost</th></tr>
<tr><th>Minimum cost for small areas of POS (based on fixed cost of a site visit)</th><th>£/100m^2 per visit for larger areas of POS</th></tr>
<tr><td>Litter removal</td><td>1 per month</td><td>Litter quantity and characteristics will be dependant on the site
Litter may collect in swales
Litter collection may be part of the general landscape maintenance
Litter collection should be undertaken at each site visit and the beginning of any maintenance task, particularly grass cutting
All litter must be removed from site</td><td rowspan="4">1 site visit with 3 men, 1 light van, mower and ancillary equipment.
Half day visit comprises 3 hours on site and 1 hour travelling.
Half day maximum area = 4000 m^2 (including pond or wetland vegetation)
Cost per visit = £249
Full day visit comprises 7 hours on site and 1 hour travelling.
One day maximum area = 10000m^2 (including pond or wetland vegetation)
Cost per visit = £498</td><td>0.67</td></tr>
<tr><td>Inspect control structures to/from swale</td><td>1 per month</td><td>Surface control structures can be slot weirs, V-notch or gabion baskets with control in the stone fill. They can be inspected without removing covers or special keys. Maintenance of control structures in manhole chambers will be more expensive.</td><td>£5/ structure</td></tr>
<tr><td>Grass cutting in swale – amenity grass</td><td>1 per month</td><td>All grass cuttings managed on site in wildlife or compost piles</td><td>1.14</td></tr>
<tr><td>Scrub clearance from bankside</td><td>1 per year</td><td>Overhanging branches and encroaching growth will normally be undertaken as part of landscape maintenance</td><td>5.83</td></tr>
<tr><td>Remove planting and silt from 25% to 30% of base and place in site piles</td><td>1 per 5 years</td><td>Silt accumulation is slow if swale is design ed as a source control feature. Carry out September to November if possible to minimise disruption to wildlife.
Only required once every 5 years</td><td colspan="2">Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment. Pond area up to 1200m^2
Cost per visit = £689
Disposal of silt by truck with mechanical grab (assuming it is not special waste) £51.18/m^3</td></tr>
<tr><td>Extra cost if silt, grass cuttings, etc are removed from site during routine maintenance</td><td>To suit other operations</td><td>Ideally all cuttings should be used on site to construct and maintain wildlife piles but this may not be the best option in public open space and removal from the site may be needed.</td><td colspan="2">£2.65/100m^2 cleared.
Assumes the waste is not classified as special waste and proportion of silt is minor (which should be the case if swale is designed as a source control feature). Disposal of silt by truck with mechanical grab (assuming it is not hazardous or special waste) £55/m^3</td></tr>
</table>

= SUDS Specific Items

Swales and filter strips

No per year	General rates - cost per visit to site	10000 m^2 site				
	Item	**No**	**Unit**	**Rate**	**Total per visit for site inc all SUDS 10000 m2 site**	**Page reference in SPON'S**
12	Litter removal	10000	$100m^2$	0.67	67	Pg 216 collection and disposal of litter from isolated grassed area
12	Inspect control structures to swale (assumes surface features and no special tools required)	4	No	5	20	Allow £5 per structure
12	Grass cutting on slopes and in bottom of swale - amenity grass	10000	$100m^2$	1.14	114	Page 214 self propelled rotary mower, 91cm cut width, removing arisings not exceeding 30 deg from horizonal (0.36 + 0.78 = 1.14)
1	Scrub clearance from bankside	10000	$100m^2$	5.83	583	Page 216 use rate for clearing leaf and other debris from verges by hand
1	Removal of all arisings (scrub clearance and vegetation)	3300	$100m^2$	2.65	87.45	Page 216 use rate for removal of arisings from areas containing shrub beds.
	Total per visit if all items completed				**871.45**	
	Total per visit for litter removal, inspection and gress cutting				**201**	
	Total annual cost				**3082.45**	
	Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow 15%				**462.37**	

Cost per visit based on labour rates

Item	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 3	8	hour	15.5	186.00	372.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small ride on mower	8	hour	8.75	35.00	70.00	Assumes rate for mower is same as for a mini excavator, self drive and no delivery charge or minimum hire
Ancillary tools and equipment	1	day	20	10.00	20.00	Allowance for tools such as strimmers, etc
Disposal of cuttings off site	1	Item	150	150.00	150.00	Cost based on small skip specific for disposal from a particular site - $6m^3$ (The more sites that are maintained the less this cost may become)
Total per visit				**249.00**	**498.00**	
Total for 12 visits per year				**2988.00**	**5976.00**	
Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow one extra visit per year				**249.00**	**498.00**	

Swale silt removal every 5 years

Assume a specific visit is made for this work	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 3	8	hour	15.5	186.00	372.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small mini excavator, rubber tracks (self drive)	8	hour	8.75	70.00	70.00	Page 15, self drive and no delivery charge. Minimum hire 8 hours
Delivery charge in Cambridge from local hire company	1	Item	30	30.00	30.00	Assume £30 for both ways
Ancillary tools and equipment	1	day	40	20.00	40.00	Allowance for tools such as strimmers, pedestrian operated scarifying equipment, etc
Disposal of silt assuming SUDS serves 1 Ha catchment (volume depends on catchment area)	0.63	m^3	51.18	161.00	161.00	Allow $0.63m^3$ per year per ha of catchment area (impermeable), based on 755kg/ha/yr and density of $1200kg/m^3$ from Darcy et al (2000). Cost from Page 106, wet clay
Total				**485.00**	**709.00**	

Notes
All rates and base costs taken from SPON'S External Works and Landscape Price Book 2008

Alternative rate per metre of swale			
Clear vegetation from swale with strimmer	100 m	149.12	Pg 256 Ditching clear only vegetation from ditch not exceeding 1.5m deep. Dispose to spoil heaps width at top 2.5m to 4m
Disposal of vegetation off site	100 m	1193	Allow extra for disposal off site by truck. Use rate from page 216 for disposal of arisings from leaf clearance based on plan area of 1m length of swale - $4.5m^2$ and a rate of £2.65/m^2 typically if shallow as required in this guide. Deeper swales will be more expensive.
Total cost per 100 metre of swale		**1342.12**	

Silt loading

Parameter	Units	Value	
Silt load (TSS)	kg/ha/yr	755	Maximum load for high density housing
Silt density in swale	kg/m^3	1200	
Silt accumulation swale	m^3/y/ha impermeable catchment area	0.63	

Maintenance requirements and costs of filter drains

Most of the maintenance will be required as part of the overall open space maintenance. The costs are based on the assumption that a specific visit to site is made to carry out the maintenance in the SUDS filter drain. If they are incorporated into the general maintenance there will only be some additional costs where extra work relating to the SUDS feature needs to be undertaken above and beyond the cost for the general landscape. Items that are specific to a SUDS filter drain that will be carried out in addition to general landscape maintenance are highlighted in blue. The costs assume that access to the site is easy. Minimum costs are based on the cost to visit a site and the rates for larger areas are based on information in the SPON's External Works and Landscape Price Book 2008 and will be updated as necessary. There is no allowance for profit in the costs.

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Frequency</th><th rowspan="2">Comments</th><th colspan="2">Cost</th></tr>
<tr><th>Minimum cost for small areas of POS (based on fixed cost of a site visit)</th><th>£/m per visit for longer lengths</th></tr>
<tr><td>Litter removal</td><td>1 per month</td><td>Litter quantity and characteristics will be dependant on the site
Litter may collect on top of filter drains
Litter collection may be part of the general landscape maintenance
Litter collection should be undertaken at each site visit and the beginning of any maintenance task, particularly grass cutting
All litter must be removed from site</td><td rowspan="2">1 site visit with 2 men, 1 light van and ancillary equipment.

Half day visit comprises 3 hours on site and 1 hour travelling.
Half day (including any other open areas or SUDS in site)
Cost per visit = £152

Full day visit comprises 7 hours on site and 1 hour travelling.
Full day (including any other open areas or SUDS in site)
Cost per visit = £304</td><td>0.67</td></tr>
<tr><td>Inspect control structures to/from filter drains</td><td>1 per month</td><td>Surface control structures can be slot weirs, V-notch or gabion baskets with control in the stone fill. They can be inspected without removing covers or special keys
Filter drains may well have control structures located in manholes or inspection chambers. Maintenance of control structures in manhole chambers will be more expensive.</td><td>£20/structure</td></tr>
<tr><td>Remove top 300mm of gravel, clean and replace.

Remove silt from site</td><td>1 per 5 years</td><td>Silt accumulation is slow if filter drain is protected by a filter strip or other source control feature</td><td colspan="2">Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment. Filter drain up to 100m length
Cost per visit = £866
Disposal of silt by truck with mechanical grab (assuming it is not hazardous or special waste) £55/m^3</td></tr>
</table>

= SUDS Specific Items

Filter drains

No per year	General rates - cost per visit to site	No	Unit	Rate	Total per visit for site inc all SUDS	Page reference in SPON'S
					10000 m2 site	
12	Litter removal	10000	$100m^2$	0.67	67	Pg 216 collection and disposal of litter from isolated grassed area assume filter drain is maintained as part of wider management of area
12	Inspect control structures to filter drain (assumes surface features and no special tools required)	4	No	20	20	Allow £20 per structure as they are more likley to be in manholes for filter drains
	Total per visit if all items completed				**87**	
	Total per visit for litter removal, inspection and gress cutting				**87**	
	Total annual cost				**1044**	
	Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow 15%				**156.6**	

Cost per visit based on labour rates

Item	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 2	8	hour	15.5	124.00	248.00	Page 8 includes overheads, tools, site kit, etc but not profit. Assume that if visit is specifically to maintain filter drain then a gang of 2 men will be used.
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Ancillary tools and equipment	1	day	20	10.00	20.00	Allowance for tools
Total per visit				**152.00**	**304.00**	
Total for 12 visits per year				**1824.00**	**3648.00**	
Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow one extra visit per year				**152.00**	**304.00**	

Gravel removal by machine every 5 years

Assume a specific visit is made for this work	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 2	8	hour	15.5	124.00	248.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Small mini excavator, rubber tracks (self drive)	8	hour	8.75	35.00	70.00	Page 15, self drive and no delivery charge. Minimum hire 8 hours
Delivery charge in Cambridge from local hire company	1	Item	30	30.00	30.00	Assume £30 for both ways
Disposal of gravel (top 300mm). This is worst case costs. Ideally the gravel would be cleaned and replaced. Only the geotextile would require replacement. Assume 100m length	18.00	m^3	26.77	240.93	481.86	Assume can excavate and replace 100m per day. Excavation = 0.3 x 0.6 x 100 = $18m^3$. 0.6m wide drain and disposal rate is for slightly contaminated material (majority will be the clean gravel pieces) Pg 105 disposal mechanical Recycled Materials Ltd
Install new geotextile assume 100m length	60.00	m^2	0.95	28.50	57.00	Pg 261 extra over for filter wrapping pipes with Terram or similar filter fabric. Replace top geotextile 0.6m by 100mm per metre length of drain
Replace gravel assume 100m length	18.00	m^3	40.7	366.30	732.60	Gravel = 0.3 x 0.6 x 100 = 18m3. 0.6m wide drain Page 137 Type 1 granular fill (rate /m^3 compacted material and compaction only)
Total				**447.93**	**865.86**	

Notes
All rates and base costs taken from SPON'S External Works and Landscape Price Book 2008

Alternative rate per metre of filter drain

Excavate gravel and replace	1	m	10.89	Pg 367 Excavate trench includes for excavation and filling with Type 2 (cost will be similar for filter drain material) and disposal of surplus soil. Not exceeding 0.5m depth.
Disposal off site	0.18	m^3	26.77	Allow extra for disposal as the gravel could be slightly contaminated.
Total cost per metre of filter drain			**37.66**	

Maintenance of canals, rills and treatment channels

Most of the maintenance will be required as part of the overall open space maintenance. The costs are based on the assumption that a specific visit to site is made to carry out the maintenance in the SUDS channels. If they are incorporated into the general maintenance there will only be some additional costs where extra work relating to the SUDS feature needs to be undertaken above and beyond the cost for the general landscape. Items that are specific to a SUDS channels that will be carried out in addition to general landscape maintenance are highlighted in blue. The costs assume that access to the site is easy. Minimum costs are based on the cost to visit a site and the rates for larger areas are based on information in the SPON's External Works and Landscape Price Book 2008 and will be updated as necessary. There is no allowance for profit in the costs.

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Frequency</th><th rowspan="2">Comments</th><th colspan="2">Cost</th></tr>
<tr><th>Minimum cost for small areas less (based on fixed cost of a site visit)</th><th>£ per visit for lengths greater than ??m</th></tr>
<tr><td>Litter removal</td><td>1 per month</td><td>Litter quantity and characteristics will be dependant on the site
Litter may collect on top of filter drains
Litter collection may be part of the general landscape maintenance
Litter collection should be undertaken at each site visit and the beginning of any maintenance task, particularly grass cutting
All litter must be removed from site</td><td rowspan="2">1 site visit with 2 men, 1 light van and ancillary equipment.
Half day visit comprises 3 hours on site and 1 hour travelling.
Half day
Cost per visit = £152

Full day visit comprises 7 hours on site and 1 hour travelling.
Full day
Cost per visit = £304</td><td>0.67 (general rate for litter removal on whole site)</td></tr>
<tr><td>Inspect control structures to/from filter canals, rills or treatment channels</td><td>1 per month</td><td>Surface control structures can be slot weirs, V-notch or gabion baskets with control in the stone fill. They can be inspected without removing covers or special keys
Maintenance of control structures in manhole chambers will be more expensive.</td><td>£5/ structure</td></tr>
<tr><td>Remove silt.

Remove silt from site</td><td>1 per 5 years</td><td>Silt accumulation is slow if canal is protected by source control feature
Only required once every 5 years</td><td colspan="2">Assume 1 site visit with 3 men, 1 light van and ancillary equipment. canal up to 100m length
Cost per visit = £485
Disposal of silt by truck with mechanical grab (assuming it is not hazardous or special waste) £55/m^3</td></tr>
</table>

= SUDS Specific Items

Canals and Rills

General rates - cost per visit to site **10000 m2 site**

No per year	Item	No	Unit	Rate	Total per visit for site inc all SUDS 10000 m2 site	Page reference in SPON'S
12	Litter removal	10000	100m2	0.67	67	Pg 216 collection and disposal of litter from isolated grassed area assume rill is maintained as part of wider management of area
12	Inspect control structures to swale (assumes surface features and no special tools required)	4	No	5	20	Allow £5 per structure
1	Scrub clearance and vegetation management in canals and rills	10000	100m2	5.83	583	Page 216 use rate for clearing leaf and other debris from verges by hand
1	Removal of all arisings (scrub clearance and vegetation)	3300	100m2	2.65	87.45	Page 216 use rate for removal of arisings from areas containing shrub beds.
	Total per visit if all items completed				**757.45**	
	Total per visit for litter removal, inspection and gress cutting				**87**	
	Total annual cost				**1714.45**	
	Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow 15%				**257.1675**	

Cost per visit based on labour rates

Item	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 2	8	hour	15.5	124.00	248.00	Page 8 includes overheads, tools, site kit, etc but not profit. Assume that if visit is specifically to maintain canals or rills then a gang of 2 men will be used.
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Ancillary tools and equipment	1	day	20	10.00	20.00	Allowance for tools such as strimmers, etc
Disposal of cuttings off site	1	Item	150	150.00	150.00	Cost based on small skip specific for disposal from a particular site - 6m^3 (The more sites that are maintained the less this cost may become)
Total per visit				**152.00**	**304.00**	
Total for 12 visits per year				**1824.00**	**3648.00**	
Contingency to allow for ad hoc work such as repairing erosion, vandalism, etc. Allow one extra visit per year				**152.00**	**304.00**	

Silt removal by hand every 5 years

Assume a specific visit is made for this work	No	Unit	Rate	Half day (4 hours)	Full day (8 hours)	Page reference in SPON'S
Labourers x 2	8	hour	15.5	124.00	248.00	Page 8 includes overheads, tools, site kit, etc but not profit
Light van (eg transit)	1	day	36	18.00	36.00	Page 8 includes fuel, insurance, etc
Ancillary tools and equipment to scarify and spike	1	day	40	20.00	40.00	Allowance for tools such as strimmers, pedestrian operated scarifying equipment, etc
Disposal of silt from SUDS serving 1Ha catchment (volume depends on catchment area)	0.63	m^3	51.18	161.00	161.00	Allow 0.63m^3 per year per ha of catchment area (impermeable), based on 755kg/ha/yr and density of 1200kg/m^3 from Darcy et al (2000). Cost from Page 106, wet clay
Total				**323.00**	**485.00**	

Notes
All rates and base costs taken from SPON'S External Works and Landscape Price Book 2008

Silt loading

Parameter	Units	Value	
Silt load (TSS)	kg/ha/yr	755	Maximum load for high density housing
Silt density in pond	kg/m^3	1200	
Silt accumulation pond	m^3/y/ha impermeable catchment area	0.63	

Minimum area for application of unit rates from SPONS External works and landscape price book, 2008

Base minimum area on the area that can be covered by grass cutting

For half a day
Assume 1 hour travelling
Time on site = 3 hours
Assume slowest grass cutting speed around SUDS features and on small sites
Speed = 1mph
Width of cut - assume small mower 1m width
Capacity = 1529m^2/h
Area in 3 hours = 4587m^2
Say 4,000m^2 allowing for set up, etc
Note the actual rate could be lower or higher than this depending on mower width and the site layout

For full day
Assume 1 hour travelling
Time on site = 7 hours
Assume slowest grass cutting speed around SUDS features and on small sites
Speed = 1mph
Width of cut - assume small mower 1m width
Capacity = 1529m^2/h
Area in 7 hours = 10703m^2
Say 10,000m^2 allowing for set up, etc
Note the actual rate could be lower or higher than this depending on mower width and the site layout

For removing wetland vegetation and silt from ponds/wetlands, basins and swales
Assume 1 hour travelling
Time on site = 7 hours
Assume mid range excavation rate due to need for care around SUDS features and on small sites
Page 404 SPONS
Rate = 0.08m^3 per minute with 1.5 tonne mini excavator
Volume of material removed in 7 hours
33.6 m^3
Area covered in 7 hours, assuming 100mm silt per m^2 = 33.6/0.1 = 336m^2
Say 300m^2 allowing for set up, etc
This is 25% of pond area
Pond area total = 1200m^2

For removing gravel from filter drains
Assume 1 hour travelling
Time on site = 7 hours
Assume mid range excavation rate due to need for care around SUDS features and on small sites
Page 404 SPONS
Rate = 0.08m^3 per minute with 1.5 tonne mini excavator
Volume of material removed in 7 hours
33.6
Length covered in 7 hours, assuming 300mm deep layer per m = 33.6/0.3 = 112m
Say 100m allowing for set up, etc

C. Example of how to integrate SUDS into a development and showing where SUDS would be adopted by Cambridge City Council

The following example shows how imaginative design can provide a good quality SUDS that enhances the local environment, whilst at the same time reducing construction difficulties and costs.

The scheme is a housing development with an area of public open space around one side. It is located in the village of Cambourne, approximately 13km west of Cambridge.

The first stage in the SUDS design is to consider the natural flow routes across the site. On this site the contours show it would fall from the north-west to the south-east of the site and this is the general flow route that is adopted in the SUDS.

The development includes a substantial area of public open space that was incorporated as part of the SUDS scheme as shown on the plan of the scheme below. In developments in Cambridge the open space could be used to replicate the water meadows in the centre of Cambridge and also enhance the biodiversity provision within the SUDS. A series of very shallow swales and basins provide enhanced treatment and management of water flows across a wetland landscape around the outside of the development.

Summary of the Cambourne scheme technical details

The site was divided into two sub catchments based on the topography and layout of the development. The site is designed to attenuate runoff form the site based on a design rainfall event of 1 in 100 years with an extra allowance of 20% on the rainfall intensity to allow for climate change. The SUDS management train provides at least two levels of treatment to the runoff from the site, and more importantly at least one level of treatment is provided before water enters the ponds/wetlands on the site, therefore maximising the amenity and wildlife benefits.

Interception storage was provided by using permeable pavements, water butts and under-drained swales which should prevent runoff for small rainfall events.

The attenuation storage is provided in a series of basins, swales and wetlands or ponds that are incorporated into the open space around the development. At the time this system was designed the concept of long term storage was not well established. However. it would be easy to redesign the scheme to make one of the basins or wetlands an off-line area for long term storage, or to redesign the flow controls to achieve this.

Monitoring of the hydraulic performance of the scheme is currently being carried out. It would appear to be effectively managing runoff and the rate of runoff from the outfall shows reduced rates, overall volumes and frequency compared to a control site. It may appear to be over designed from a hydraulic point of view, but volumes were determined using recognised methodology, and this view would ignore the integration of important aspects of amenity, good landscape design and biodiversity provision within the scheme.

SUDS layout at Cambourne

A habitat survey has shown that the SUDS provide a greater diversity than normal open space. The maintenance of the SUDS has been incorporated into the day to day maintenance of the open space. The extra costs for maintaining the SUDS are minimal when compared to those for maintaining normal open spaces.

The adoption model originally agreed for this site was as follows:

- Swales and the basin within the site boundary – Cambridge Housing Society
- Permeable pavements – Cambridgeshire County Council
- Swales, wetlands and ponds in the greenway around the outside of the development are owned by Cambridgeshire County Council and were to be maintained by Cambridgeshire Wildlife Trust.

In practice the site is now entirely managed by the Housing Society, which has entered into an agreement with Cambridgeshire County Council to maintain the off site SUDS in the greenway and will arrange for suction sweeping of the permeable pavement (which are public road areas) until it is adopted by the Highways Department.

It is also important to note that the scheme was not ideal in that the SUDS were not considered at the development concept stage. Therefore the SUDS design was “bolted onto” an existing development layout that was intended to be drained using conventional drainage. Despite this, it does show how source control and green SUDS can be integrated into housing developments. It was also not subject to the rigorous verification procedures required by Cambridge City Council as detailed in Section 13 Adoption Requirements.

D. Checklist of adoption requirements

The following checklist can be used to confirm that the City Council's requirements for adoption have been met. This accreditation process follows advice in The SUDS Manual – CIRIA C697, London 2007 and Environment Agency guidance.

Ref No	Item	Date agreed with Cambridge City Council
1.	**Conceptual design**	
	The SUDS Manual requirements	
	• provide a clear explanation of the SUDS proposal following CIRIA C697 (The SUDS Manual) guidance	
	• Flow routes through development	
	• Attenuation storage locations identified	
	• Source control provision and interception storage identified	
	• Long term storage locations identified	
	• Landscape and ecology criteria defined	
	• Treatment levels identified	
	Cambridge specific requirements	
	• Mimic natural drainage patterns and landscape of Cambridge	
	• SUDS as shallow as possible	

2.	**Outline design**	
	The SUDS Manual requirements	
	• Drainage design criteria agreed with Environment Agency including greenfield runoff rates and frequency of volumes	
	• Source control and interception storage provided and volumes defined – no runoff from site for events up to 5mm (or stated value)	
	• Attenuation storage provided and volumes defined – storage for 1% and 3.3% annual probability	
	• Long term storage provided and volumes defined – storage for 1% annual probability, 6 hour duration event released to infiltration or at a rate of 2l/s/ha	
	• conveyance – describe flow routes, low flow recurrence intervals	
	• Control structures defined and sized	
	• Sufficient number of treatment stages provided	
	• Exceedance and overland flow routes	

3.	**Detailed drainage design**	
	General – The SUDS Manual	
	• Detail – check drainage pathways reflect natural drainage patterns	
	• Detail – check interception, attenuation and long term storage volumes provided	
	• Detail – check flow controls provided in correct place to ensure operates when required	
	• Detail – check sufficient treatment stages provided	
	• Detail – check biodiversity design requirements provided	
	Ponds and wetlands – Cambridge specific	
	• Design in accordance with The SUDS Manual	
	• Access provision for maintenance	
	• Side slopes less than 1 in 3 and safety bench	
	• Underwater slopes less than 1 I 3 and 150mm wet bench	
	• Biodiversity design considerations	
	Fencing provision appropriate (fencing not normally required)	
	• 150mm topsoil to slopes	
	• Interpretative boards	
	• If liner used is it covered by 300mm topsoil?	
	Retention and infiltration basins – Cambridge specific	
	• Design in accordance with The SUDS Manual	
	• Access provision for maintenance	
	• Side slopes less than 1 in 3	
	• Biodiversity design considerations	
	Fencing provision appropriate (fencing not normally required)	
	• 150mm topsoil to slopes	
	• Interpretative boards	
	• If liner used is it covered by 300mm topsoil?	
	• Root zone in base of underdrained swales	
	• Drainage to swale does not use gullies	
	Filter drains – Cambridge specific	
	• Design in accordance with The SUDS Manual	
	• Access provision for maintenance	
	• Drainage to filter drain does not use gullies	
	• Interpretative boards	

	Canals, rills and other channels – Cambridge specific	
	• Design in accordance with The SUDS Manual	
	• Access provision for maintenance	
	• Interpretative boards	
	Inlets, outlets and controls – Cambridge specific	
	• Design in accordance with The SUDS Manual	
	• Simple orifices or weirs located at surface wherever possible	
	• Overflow route provided to bypass control if it becomes blocked	

4.	**Health and safety**	
	• Provide CDM designer's risk assessment – for all SUDS features, inlets, outlets and controls.	
	• Hazards designed out wherever possible (e.g. entry to confined spaces eliminated, deep excavation eliminated)	

5.	**Construction - Verification**	
	• contractor method statement – control of silt and other contamination during construction	
	• Photographs of excavations and confirmation of soil conditions	
	• Photographs and details of as built inlets, outlets and controls	
	• Topsoil/rootzone sources, certificates and depths	
	• Planting list, method statement and initial maintenance regime	
	• Subsoil depth confirmed	
	• Filter drain material sources and certificates	
	• Source and test certificates for membrane liners (if used)	
	• Installation CQA sheets and test results for membrane (if used)	
	• Photos of completed feature	
	• As constructed drawings	

E. Glossary

Algae	Simple plants ranging from single cells to large plants.
Amenity	The quality of being pleasant or attractive; agreeableness. A feature that increases attractiveness or value, especially of a piece of real estate or a geographic location
Attenuation	Reduction of peak flow and increased duration of a flow event.
Balancing pond	A pond designed to attenuate flows by storing runoff during the storm and releasing it at a controlled rate during and after the storm. The pond always contains water.
Basin	A ground depression acting as a flow control or water treatment structure that is normally dry and has a proper outfall, but is designed to detain stormwater temporarily.
Berm	A mound of earth formed to control the flow of surface water.
Biodiversity	The diversity of plant and animal life in a particular habitat
Bioretention area	A depressed landscape area that is allowed to collect runoff so it percolates through the soil below the area into an underdrain, thereby promoting pollutant removal. Also known as a rain garden
Block paving	Pre-cast concrete or clay brick sized flexible modular paving system.
Bund	A barrier, dam, or mound usually formed from earthworks material and used to contain or exclude water (or other liquids) from an area of the site.
Catchment	The area contributing surface water flow to a point on a drainage or river system. Can be divided into sub-catchments.
Construction (Design and Management) Regulations 2007 (CDM)	Construction (Design and Management) Regulations 2007, which emphasise the importance of addressing construction health and safety issues at the design phase of a construction project.
Construction Quality Assurance (CQA)	A documented management system designed to provide adequate confidence that items or services meet contractual requirements and will perform adequately in service. CQA usually includes inspection and testing of installed components and recording the results.
Conventional drainage	The traditional method of draining surface water using subsurface pipes and storage tanks.
Conveyance	Movement of water from one location to another.
Curtilage	Land area within property boundaries.
Deposition	Laying down of matter via a natural process.

Retention basin	A vegetated depression that is normally dry except following storm events. Constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Dewatering	The removal of groundwater/surface water to lower the water table.
Dry	Free of water under dry weather flow conditions.
Erosion	The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface
Filter drain	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage.
Filter strip	A vegetated area of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Filtration	The act of removing sediment or other particles from a fluid by passing it through a filter.
Forebay	A small basin or pond upstream of the main drainage component with the function of trapping sediment.
Formation level	Surface of an excavation prepared to support a pavement
Freeboard	Distance between the design water level and the top of a structure, provided as a precautionary safety measure against early system failure.
Geocellular structure	A plastic box structure used in the ground, often to attenuate runoff.
Geomembrane	An impermeable plastic sheet, typically manufactured from polypropylene, high density polyethylene or other geosynthetic material.
Geotextile	A plastic fabric that is permeable.
Green roof	A roof with plants growing on its surface, which contributes to local biodiversity. The vegetated surface provides a degree of retention, attenuation and treatment of rainwater, and promotes evapotranspiration. Sometimes referred to as an alternative roof.
Groundwater	Water that is below the surface of ground in the saturation zone.
Habitat	The area or environment where an organism or ecological community normally lives or occurs
Impermeable	Will not allow water to pass through it.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Infiltration (to the ground)	The passage of surface water into the ground.
Infiltration basin	A dry basin designed to promote infiltration of surface water to the ground.
Infiltration device	A device specifically designed to aid infiltration of surface water into the ground.

Infiltration trench	A trench, usually filled with permeable granular material, designed to promote infiltration of surface water to the ground.
Open water	Clear water surface i.e. free from submerged or floating aquatic vegetation.
Pavement	The road or car park surface and underlying structure, usually asphalt, concrete, or blockpaving. Note: the path next to the road for pedestrians (the UK colloquial term of pavement) is the footway.
Permeable pavement	A permeable surface that is paved and drains through voids between solid parts of the pavement.
Permeable surface	A surface that is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration of water to the sub-base through the pattern of voids, for example concrete block paving.
Pervious surface	A surface that allows inflow of rainwater into the underlying construction or soil.
Pollution	A change in the physical, chemical, radiological, or biological quality of a resource (air, water or land) caused by man or man's activities that is injurious to existing, intended, or potential uses of the resource.
Pond	Permanently wet depression designed to retain stormwater above the permanent pool and permit settlement of suspended solids and biological removal of pollutants.
Porous surface	A surface that infiltrates water to the sub-base across the entire surface of the material forming the surface, for example grass and gravel surfaces, porous concrete and porous asphalt.
Porous paving	A permeable surface that drains through voids that are integral to the pavement.
Public open space	The open space required under the City Council's open space & recreation standard is defined as any land laid out as a public garden or used for the purposes of public recreation. This means space which has unimpeded public access, and which is of a suitable size and nature for sport, active or passive recreation or children and teenagers' play. Private or shared amenity areas, for example in a development of flats, or buffer landscape areas are not included as public open space.
Rainfall event	A single occurrence of rainfall before and after which there is a dry period that is sufficient to allow its effect on the drainage system to be defined.
Rainwater harvesting or rainwater use system	A system that collects rainwater from where it falls rather than allowing it to drain away. It includes water that is collected within the boundaries of a property, from roofs and surrounding surfaces.
Recycling	Collecting and separating materials from waste and processing them to produce marketable products.
Risk	The chance of an adverse event. The impact of a risk is the combination of the probability of that potential hazard being

	realised, the severity of the outcome if it is, and the numbers of people exposed to the hazard.
Risk assessment	"A carefully considered judgement" requiring an evaluation of the risk that may arise from the hazards identified, combining the various factors contributing to the risk and then evaluating their significance.
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or rainfall is particularly intense.
Sediments	Sediments are the layers of particles that cover the bottom of water-bodies such as lakes, ponds, rivers, and reservoirs.
Sewer	A pipe or channel taking domestic foul and/or surface water from buildings and associated paths and hard-standings from two or more curtilages and having a proper outfall.
Silt	The generic term for waterborne particles with a grain size of 4-63 μm, i.e. between clay and sand.
Soakaway	A sub-surface structure into which surface water is conveyed, designed to promote infiltration.
Soil	The terrestrial medium on which many organisms depend, which is a mixture of minerals (produced by chemical, physical and biological weathering of rocks), organic matter, and water. It often has high populations of bacteria, fungi, and animals such as earthworms.
Storm	An occurrence of rainfall, snow, or hail.
Sub-base	A layer of material on the sub-grade that provides a foundation for a pavement surface.
Sub-grade	Material, usually natural insitu, but may include Capping layer, below Formation level of a Pavement.
SUDS	Sustainable Urban Drainage Systems: a sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.
Sump	A pit that may be lined or unlined and is used to collect water and sediments before being pumped out.
Surface water	Water that appears on the land surface, e.g. lakes, rivers, streams, standing water, and ponds.
Swale	A shallow vegetated channel designed to conduct and retain water, but may also permit infiltration. The vegetation filters particulate matter.
Treatment	Improving the quality of water by physical, chemical and/or biological means.
Vortex flow control	The induction of a spiral/vortex flow of water in a chamber used to control or restrict the flow.
Waste	Any substance or object that the holder discards, intends to discard, or is required to discard.
Wetland	Flooded area in which the water is shallow enough to enable the growth of bottom-rooted plants.

F. Cambridge SUDS Design Guide
Consultees June 09

Name	Organisation
Sian Reid	Executive Councillor Cambridge City Council
Julie Smith	Executive Councillor Cambridge City Council
Alistair Wilson	Cambridge City Council
Debbie Kaye	Cambridge City Council
Guy Belcher	Cambridge City Council
Dinah Foley-Norman	Cambridge City Council
Alan Wingfield	Cambridge City Council
Jonathan Brookes	Cambridge City Council
Mark Parsons	Cambridge City Council
Ian Boulton	Cambridge City Council
Jo Clark	Countryside Properties
Nigel Borrell	Countryside Properties
Jo Whiteman	Countryside Properties
Andrew Carrington	Countryside Properties
Michael Lister	Countryside Properties
Marcia Whitehead	Bidwells
Guy Kaddish	BIdwells
Helen Thompson	Bidwells
Jason Tyers	Bidwells
David Banfield	Barratt Homes
Andrew Sharpe	Grovesnor
Neil Hardiman	USS
Ed Skeates	USS/Grovesnor
Richard Burton	Terence O'Rourke
Geoff Boulton	SRR Planning
Paul Milliner	Cambridge University
Ken Banfield	Anglian Water
Rob Morris	Anglian Water
Tony Wadhams	Environment Agency
Richard Taylor	Environment Agency
Jenny Gough	Environment Agency
Dan Curtis	Environment Agency
Daniel Clarke	Cambridgeshire Horizons
Tom Read	Cambridgeshire Horizons
Sheryl French	Cambridgeshire Horizons
Mark Vigor	Cambridgeshire County Council
Chris Capps	Cambridgeshire County Council
Richard Preston	Cambridgeshire County Council
Wendy Hague	Cambridgeshire County Council
Tom Barrance	South Cambridgeshire District Council
Rob Mungovan	South Cambridgeshire District Council
David Hamilton	South Cambridgeshire District Council
Richard Hales	South Cambridgeshire District Council
Pat Matthews	South Cambridgeshire District Council
Jonathan Dixon	South Cambridgeshire District Council
Paul Shaffer	CIRIA
Nancy Harrison	Anglia Ruskin University
Alvin Helden	Anglia Ruskin University
Dr Stuart Arnold	Ramboll
Alison Mallows	Halcrow
Simon Darch	Hannah-Reed
Mick Thurman	Cambridge Water
Janet Nuttall	Natural England
Vicky Dawe	DEFRA
Carolin Gohler	Cambridge Past, Present and Future
Coton Parish Council	
Fen Ditton Parish Council	
Fulbourn Parish Council	
Girton Parish Council	
Great Shelford Parish Council	
Histon & Impington Parish Councils	
Horningsea Parish Council	
Madingley Parish Council	